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In vitro human skin permeation of Methylchloroisothiazolinone (MCI) and Methylisothiazolinone (MI)

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Introduction: Biocides are used in a plethora of cosmetic and industrial products, and several are recognized irritants or sensitizers. Skin diseases may therefore develop as biocides are in frequent contact with skin. A commonly used biocide known for its antibacterial effects is the mixture of methylchloroisothiazolinone (MCI) and methylisothiazolinone (MI), especially in water-based personal care products and cosmetics. However, the MCI/MI mixture is considered an irritant; and may cause contact allergy even after a single exposure. Some studies have determined permeation rates through the animal skin, but data are lacking for humans. The initial aim of this study was to assess the permeation of MCI and MI both separately and as a mixture through freshly dermatomed human skin (800 µm) in a flow-through diffusion cell system.

Material & methods: Different concentrations of aqueous standards (1 and 5 µg/ml for both substances) and various commercial products (a cleaning product, an antifungal product, and two moisturizing creams) were applied. Skin was exposed for 15 to 20 hours. In parallel, the irritant effects of MCI/MI and MI were quantitatively assessed using, dermatopathological tests (i.e. histology) where different concentrations of MCI/MI and MI were applied to fresh excised human skin and left for either 6-h or 24-h. Concentrations applied were 75:25, 150:50, 375:125 and 750:250 ppm for the MCI/MI mixture and 500 ppm for MI alone.

Results: These results confirmed that MCI and MI permeate through human skin; however, MI permeates faster than MCI through the skin (<1h and 4 to 5 h, respectively) which could be explained by the retention of MCI in the skin. The permeation flux (J) was not influenced by concentrations applied; hence, the passive diffusion was not a limiting factor for J. Higher concentrations of MCI/MI increased local toxicity rather than permeation through the skin. Lastly, histopathological results showed a dose-response with focal spongiotic change in epidermis at 750/250 ppm of MCI/MI solution following a 6h exposure and at 375/125 ppm following a 24h exposure. No change was observed after exposure to MI.

Conclusion: Overall, MCI and MI permeate through human skin relatively quickly, but in reacting with proteins, they may be stocked in skin.